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DEVICE FOR ADJUSTING THE GAIN FACTOR OF AUTOMATIC CONTROL SYSTE--ETC(U)

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AUTOMATIC CONTROL SYSTEMS

by

B.V. Novoselov, A.V. Biryukov, V.M. Vinnichenko

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By: B.V. Novoselov, A.V. Biryukov, V.M. Vinnichenko

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

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DEVICE FOR ADJUSTING THE GAIN FACTOR OF AUTOMATIC CONTROL SYSTEMS

B. V. Novoselov, A. V. Biryukov, V. M. Vinnichenko

This invention is in the field of automatic control system technology, and it can be used to create automatic tuners for automatic control systems, and, with certain modifications, self-tuning systems.

We know of devices for adjusting the gain factor of SAR (automatic control system) which contain a servomotor with a reducer, a shaper and a circuit for isolating the phase of the error signal connected to one of the inputs of the device.

The proposed device is different, because it includes a circuit for isolating the phase of the reference signal, a test signal sensor connected to its input, and two relays whose windings are connected to the outputs of the circuits for isolating the phase of the reference signal and the error signal, respectively. Their outputs are connected to the shaper, which is connected to the servomotor.

The test signal sensor is equipped with a rotating transformer which is connected to the motor through a reducer. Here the rotor winding of the rotating transformer is connected to the input of the device, while one of its ends is also connected to the output of the sensor.

The shaper contains a polarized relay, two resistors, two capacitors, and a power source. The positive terminal of this power source is connected to one capacitor through a resistor and the normally open contacts of the error signal relay and the reference signal relay, while it is connected to the other relay through a resistor and the normally closed contacts of the same relays. The second outputs of the capacitors are connected to a common bus. The winding of the polarized relay is connected in parallel to one capacitor through the normally open contacts of the reference signal relay, while it is connected in parallel to the other capacitor through the normally closed contacts of this same relay. In this case, the contact of the polarized relay is connected in the supply circuit of the servomotor.

The proposed device is intended for the automatic adjustment of the gain factor of systems according to their phase-frequency characteristic withthe rest of their coefficients adjusted in a particular manner, assuming that the gain factor of the control system primarily determines its resonance frequency or "hardness". The value of the phase-frequency characteristic at the resonance frequency is constant and equal to 90°. Tuning is carried out according to the deviation of the actual value of the phase-frequency characteristic at the resonance frequency from 90°.

Figure 1 shows a block diagram of an automatic control system with the proposed device for adjusting the gain factor of the SAR, and Fig. 2 - a schematic diagram of the shaper with the servomotor.

The motor 1, which is kinematically connected to the slide of potentiometer 2 through reducer 3, is fed on the control winding through contact 4 from source U_1. Contact 4 belongs to polarized relay 5, which leads into shaper 6. Shaper 6 operates at signals from the two identical phase isolation circuits 7 and 8 by means of relays 9 and 10. Phase isolation circuit 7 contains electronic amplifier 11, phase-sensitivie rectifier 12, differentiating circuit 13, and flip-flop 14, whose load is relay 9. Circuit 8, which has similar components, is loaded by relay 10.

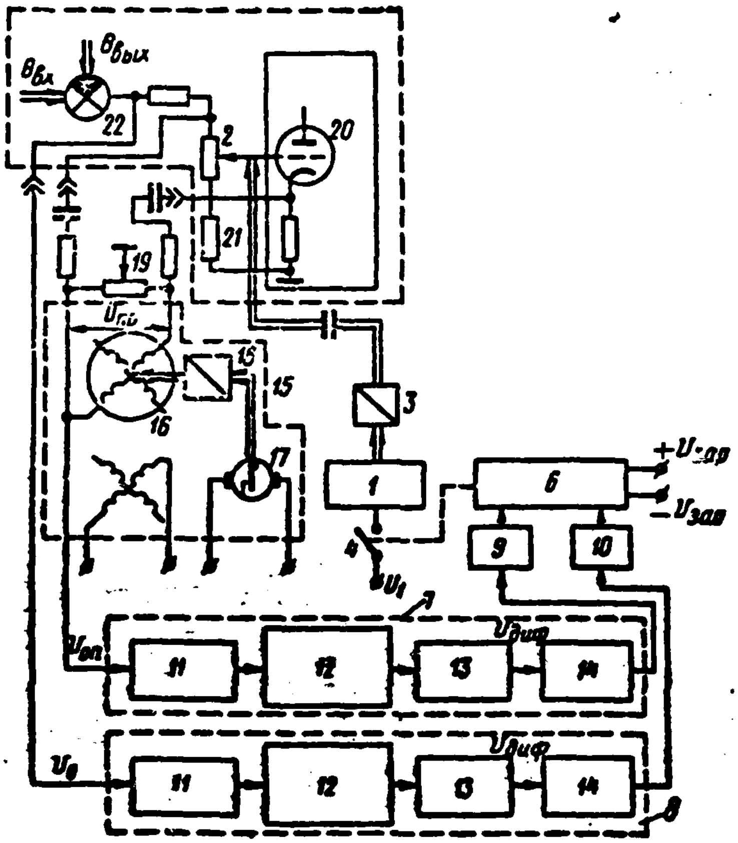

Fig. 1.

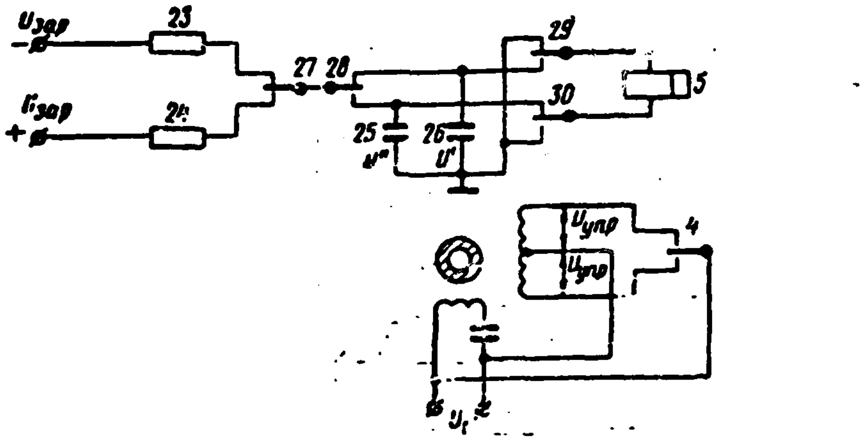

Fig. 2.

Test signal sensor 15 consists of rotating transformer 16 and direct-current motor 17 with a stabilized rotation rate, which are connected by reducer 18. It is used to create the reference signal U_{on}, which is sent to phase isolation circuit 7, and the test signal U_{np}, which is sent to the potentiometer 19. The terminal points of the latter are connected to the input of the system's error signal amplifier, which is one of the outputs of the potentiometer 2, and to the cathode of the first tube 20 of the amplifier. The second output of potentiometer 2 is connected to a common point of the amplifier through resistor 21. The output of the comparison device 22 of the tuned system is connected to the input of the phase isolation circuit 8.

The shaper 6 consists of two resistors 23 and 24 (see Fig. 2) and two capacitors 25 and 26, which are switched by contact 27 of electromagnetic relay 10 and contact 28 of relay 9; polarized relay 5 is connected to the capacitors through switching contacts 29 and 30 of relay 9.

The system operates as follows.

In its original position, potentiometer 2 (Fig. 1) is completely out and the control system has the minimum gain factor. In this case, the amplitude of the test signal U_{np} which is sent to the input of the system's amplifier turns out to be much lower than the amplitude of the signal which is passed to the cathode of tube 20. The error signal U_e appears at the output of the system's comparison unit 22. The error signal and the reference signal U_{on} are sent to the inputs of phase isolation circuits 7 and 8; passing directly through electronic amplifiers 11, phase-sensitive rectifiers 12, differentiating circuits 13 and flip-flops 14, they act on relays 9 and 10 at the time when they pass through the zero position. Thus, relays 9 and 10 operate at intervals determined by the value of the phase shift between the reference signal and the error signal of the system.

During the supply of power to the circuit, when the motor 17 of sensor 15 has still not been turned on and the error signal U_e is

equal to zero, one of the capacitors 25 or 26 of shaper 6 is connected to one of the voltage supply sources of the shaper $+U_{зар}$ or $-U_{зар}$ and is charged to the voltage determined by its value and the value of resistors 23 or 24. For example, in Fig. 2, capacitor 26 is connected to source $-U_{зар}$ through resistor 23. At this time, the second capacitor of the shaper (capacitor 26 in Fig. 2) is connected by contacts 29 and 30 to the winding of polarized relay 5. After the connection of the motor 17 of the test signal sensor, when relay 10 operates, its contacts 27 switch the outputs of capacitor 26 to the power source $+U_{зар}$ of the opposite sign. In this case, the capacitor begins to recharge.

If the phase shift between the error signal of the system U_e and the reference signal U_{on} is not equal to the optimum, when relay 9 operates (Fig. 1), the voltage on capacitor 26 U' (Fig. 2) is not equal to zero. At this time, it is disconnected from the power sources (capacitor 25 is connected to it) by contacts 28, and it is connected to the winding of polarized relay 5 by contacts 29 and 30 (in this case, capacitor 25 is disconnected from the winding). Relay 5 operates, with its contact 4 connecting the motor control voltage U_1 to one of the control windings of the motor 1, depending on the value of the deviation of the phase shift from the optimum value. The operating time of the motor is determined by the value U' of the charge of capacitor 26. Motor 1, which is kinematically connected to the slide of potentiometer 2, moves it to the required position.

The system operates analogously during the next half-period.

If the phase shift is equal to the optimum value, the voltage on capacitors 25 and 26 turns out to be equal to zero during the operation of relay 9, and there is no signal for turning on motor 1, i.e., in this case, the gain factor of the system is the optimum.

Subject of Invention

1. This invention is a device for adjusting the gain factor of automatic control systems which contains a servomotor with a reducer,

a shaper, and a circuit for isolating the phase of the error signal connected to one of the device's inputs. It is different because in order to minimize the error, it contains a circuit for isolating the phase of the reference signal, the test signal sensor connected to its input, and two relays, whose windings are connected to the outputs of the circuits for isolating the phase of the reference signal and the error signal, respectively; their outputs are connected to the shaper, which is connected to the servomotor.

2. A device according to P. 1, which is different because the test signal sensor contains a rotating transformer which is connected to a motor through a reducer; in this case, the rotor winding of the rotating transformer is connected to the input of the device, and one of its ends - to the output of the sensor.

3. A device according to P. 1, which is different because the shaper contains a polarized relay, two resistors, two capacitors, and a power source. The positive terminal of this power source is connected to one capacitor through a resistor and the normally open contacts of the error signal relay and the reference signal relay, and through a resistor and the normally closed contacts of these same relays - to the other capacitor. The second outputs of the capacitors are connected to a common bus; the winding of the polarized relay is connected in parallel to one capacitor through the normally open contacts of the reference signal relay, while it is connected in parallel to the other capacitor through the normally closed contacts of this same relay. In this case, the contact of the polarized relay is included in the supply circuit of the servomotor.

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